

SEQUENCE LISTING FREE TEXT

dgoA CDS for KDPGal Aldolase

dgoA CDS for KDPGal Aldolase

dgoA CDS for KDPGal Aldolase

aroB CDS for DHQ Synthase

tktA CDS for major Transketolase isozyme

tktB CDS for minor Transketolase isozyme

Primer JWF 430

Primer JWF 449

Primer JWF 484

Primer JWF 529

Primer JWF 501

Primer JWF 499

Primer JWF 541

Primer JWF 542

Primer JWF 610

Primer JWF 611

Primer JWF 625

Primer JWF 626

Primer JWF 541

Primer JWF 542

Primer JWF 636

Primer JWF 637

Primer JWF 669

Primer JWF 670

Primer JWF 599

Primer JWF 560

Primer JWF 484

Primer JWF 529

AP20 Rec'd CTFTO 22 MAR 2006

SEQUENCE LISTING

<110> Board of Trustees operating Michigan State University
Frost, John W.

<120> Methods and Materials for the Production of Shikimic Acid

<130> 6550-000086

<150> US 60/505,658

<151> 2003-09-24

<160> 34

<170> PatentIn version 3.3

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<211> 618

<212> DNA

<213> Escherichia coli

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<221> CDS

<222> (1)..(615)

<223> dgoA CDS for KDPGal Aldolase

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Cys Gln Leu Ile Val Thr Pro Asn Ile His Ser Glu Val Ile Arg Arg	
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 Ser Asp Leu Tyr Arg Ala Gly Gln Ser Val Glu Arg Thr Ala Gln Gln
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Cys Gln Leu Ile Val Thr Pro Asn Ile His Ser Glu Val Ile Arg Arg
 85 90 95

Ala Val Gly Tyr Gly Met Thr Val Cys Pro Gly Cys Ala Thr Ala Thr
 100 105 110

Glu Ala Phe Thr Ala Leu Glu Ala Gly Ala Gln Ala Leu Lys Ile Phe
 115 120 125

Pro Ser Ser Ala Phe Gly Pro Gln Tyr Ile Lys Ala Leu Lys Ala Val
 130 135 140

Leu Pro Ser Asp Ile Ala Val Phe Ala Val Gly Gly Val Thr Pro Glu
 145 150 155 160

Asn Leu Ala Gln Trp Ile Asp Ala Gly Cys Ala Gly Ala Gly Leu Gly
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Cys Arg Leu Ile Val Thr Pro Asn Ile Gln Pro Glu Val Ile Arg Arg
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Pro Ser Ser Ala Phe Gly Pro Asp Tyr Ile Lys Ala Leu Lys Ala Val
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Leu Pro Pro Glu Val Pro Val Phe Ala Val Gly Gly Val Thr Pro Glu
145 150 155 160

Asn Leu Ala Gln Trp Ile Asn Ala Gly Cys Val Gly Ala Gly Leu Gly
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Ile Ser Ser Val Val Lys Ala Tyr Gly Gly Arg Ala Leu Ile Gly Ala
      50                      55                      60

ggt acc gta ctg aaa ccg gaa cag gta gac cag ctt gcc ggg atg ggc      240
Gly Thr Val Leu Lys Pro Glu Gln Val Asp Gln Leu Ala Gly Met Gly
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 Gly Thr Val Leu Lys Pro Glu Gln Val Asp Gln Leu Ala Gly Met Gly
 65 70 75 80
 Cys Lys Leu Ile Val Thr Pro Asn Ile Gln Pro Glu Val Ile Arg Arg
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 Pro Ser Ser Ala Phe Gly Pro Gly Tyr Ile Ser Ala Leu Lys Ala Val
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 Asn Leu Ala Gln Trp Ile Lys Ala Gly Cys Val Gly Ala Gly Leu Gly
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tcg ggc gag cag gtc atg ttg gtc acc aac gaa acc ctg gct cct ctg	144
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Tyr Leu Asp Lys Val Arg Gly Val Leu Glu Gln Ala Gly Val Asn Val	
50 55 60	
gat agc gtt atc ctc cct gac ggc gag cag tat aaa agc ctg gct gta	240
Asp Ser Val Ile Leu Pro Asp Gly Glu Gln Tyr Lys Ser Leu Ala Val	
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ctc gat acc gtc ttt acg gcg ttg tta caa aaa ccg cat ggt cgc gat	288
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ttc gcg gcg gcg agt tat cag cgc ggt gtc cgt ttc att caa gtc ccg	384
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Val Asn His Pro Leu Gly Lys Asn Met Ile Gly Ala Phe Tyr Gln Pro	
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gag tta gcg tcg ggg ctg gca gaa gtc atc aaa tac ggc att att ctt	576
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180 185 190	
gac ggt gcg ttt ttt aac tgg ctg gaa gag aat ctg gat gcg ttg ttg	624
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 195 200 205

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Glu Thr Gln Arg Ile Ile Thr Leu Leu Lys Arg Ala Gly Leu Pro Val
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Asn Gly Pro Arg Glu Met Ser Ala Gln Ala Tyr Leu Pro His Met Leu
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65 70 75 80

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Gly Ile Ser His Glu Val Cys Ser Leu Ala Gly Thr Leu Lys Leu Gly	
165 170 175	
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Ser	Asn	Leu	Thr	Leu	Trp	Ser	Gly	Ser	Lys	Ala	Ile	Asn	Glu	Asp	Ala		
385					390					395					400		
gcg	ggt	aac	tac	atc	cac	tac	ggt	gtt	cgc	gag	ttc	ggt	atg	acc	gcg		1248
Ala	Gly	Asn	Tyr	Ile	His	Tyr	Gly	Val	Arg	Glu	Phe	Gly	Met	Thr	Ala		
			405					410					415				
att	gct	aac	ggt	atc	tcc	ctg	cac	ggt	ggc	ttc	ctg	ccg	tac	acc	tcc		1296
Ile	Ala	Asn	Gly	Ile	Ser	Leu	His	Gly	Gly	Phe	Leu	Pro	Tyr	Thr	Ser		
			420					425					430				
acc	ttc	ctg	atg	ttc	gtg	gaa	tac	gca	cgt	aac	gcc	gta	cgt	atg	gct		1344
Thr	Phe	Leu	Met	Phe	Val	Glu	Tyr	Ala	Arg	Asn	Ala	Val	Arg	Met	Ala		
		435				440						445					
gcg	ctg	atg	aaa	cag	cgt	cag	gtg	atg	gtt	tac	acc	cac	gac	tcc	atc		1392
Ala	Leu	Met	Lys	Gln	Arg	Gln	Val	Met	Val	Tyr	Thr	His	Asp	Ser	Ile		
	450					455					460						
ggt	ctg	ggc	gaa	gac	ggg	ccg	act	cac	cag	ccg	gtt	gag	cag	gtc	gct		1440
Gly	Leu	Gly	Glu	Asp	Gly	Pro	Thr	His	Gln	Pro	Val	Glu	Gln	Val	Ala		
465					470					475					480		
tct	ctg	cgc	gta	acc	ccg	aac	atg	tct	aca	tgg	cgt	ccg	tgt	gac	cag		1488
Ser	Leu	Arg	Val	Thr	Pro	Asn	Met	Ser	Thr	Trp	Arg	Pro	Cys	Asp	Gln		
				485					490					495			
gtt	gaa	tcc	gcg	gtc	gcg	tgg	aaa	tac	ggt	gtt	gag	cgt	cag	gac	ggc		1536
Val	Glu	Ser	Ala	Val	Ala	Trp	Lys	Tyr	Gly	Val	Glu	Arg	Gln	Asp	Gly		
			500					505					510				
ccg	acc	gca	ctg	atc	ctc	tcc	cgt	cag	aac	ctg	gcg	cag	cag	gaa	cga		1584
Pro	Thr	Ala	Leu	Ile	Leu	Ser	Arg	Gln	Asn	Leu	Ala	Gln	Gln	Glu	Arg		
		515					520					525					
act	gaa	gag	caa	ctg	gca	aac	atc	gcg	cgc	ggt	ggt	tat	gtg	ctg	aaa		1632
Thr	Glu	Glu	Gln	Leu	Ala	Asn	Ile	Ala	Arg	Gly	Gly	Tyr	Val	Leu	Lys		

530	535	540	
gac tgc gcc ggt cag ccg gaa ctg att ttc atc gct acc ggt tca gaa			1680
Asp Cys Ala Gly Gln Pro Glu Leu Ile Phe Ile Ala Thr Gly Ser Glu			
545	550	555	560
ggt gaa ctg gct gtt gct gcc tac gaa aaa ctg act gcc gaa ggc gtg			1728
Val Glu Leu Ala Val Ala Ala Tyr Glu Lys Leu Thr Ala Glu Gly Val			
	565	570	575
aaa gcg cgc gtg gtg tcc atg tcg tct acc gac gca ttt gac aag cag			1776
Lys Ala Arg Val Ser Met Ser Ser Thr Asp Ala Phe Asp Lys Gln			
	580	585	590
gat gct gct tac cgt gaa tcc gta ctg ccg aaa gcg gtt act gca cgc			1824
Asp Ala Ala Tyr Arg Glu Ser Val Leu Pro Lys Ala Val Thr Ala Arg			
	595	600	605
gtt gct gta gaa gcg ggt att gct gac tac tgg tac aag tat gtt ggc			1872
Val Ala Val Glu Ala Gly Ile Ala Asp Tyr Trp Tyr Lys Tyr Val Gly			
	610	615	620
ctg aac ggt gct atc gtc ggt atg acc acc ttc ggt gaa tct gct ccg			1920
Leu Asn Gly Ala Ile Val Gly Met Thr Thr Phe Gly Glu Ser Ala Pro			
	625	630	635
gca gag ctg ctg ttt gaa gag ttc ggc ttc act gtt gat aac gtt gtt			1968
Ala Glu Leu Leu Phe Glu Glu Phe Gly Phe Thr Val Asp Asn Val Val			
	645	650	655
gcg aaa gca aaa gaa ctg ctg taa			1992
Ala Lys Ala Lys Glu Leu Leu			
	660		

<210> 10

<211> 663

<212> PRT

<213> Escherichia coli

<400> 10

Met Ser Ser Arg Lys Glu Leu Ala Asn Ala Ile Arg Ala Leu Ser Met
1 5 10 15

Asp Ala Val Gln Lys Ala Lys Ser Gly His Pro Gly Ala Pro Met Gly
20 25 30

Met Ala Asp Ile Ala Glu Val Leu Trp Arg Asp Phe Leu Lys His Asn
35 40 45

Pro Gln Asn Pro Ser Trp Ala Asp Arg Asp Arg Phe Val Leu Ser Asn
50 55 60

Gly His Gly Ser Met Leu Ile Tyr Ser Leu Leu His Leu Thr Gly Tyr
65 70 75 80

Asp Leu Pro Met Glu Glu Leu Lys Asn Phe Arg Gln Leu His Ser Lys
85 90 95

Thr Pro Gly His Pro Glu Val Gly Tyr Thr Ala Gly Val Glu Thr Thr
100 105 110

Thr Gly Pro Leu Gly Gln Gly Ile Ala Asn Ala Val Gly Met Ala Ile
115 120 125

Ala Glu Lys Thr Leu Ala Ala Gln Phe Asn Arg Pro Gly His Asp Ile
130 135 140

Val Asp His Tyr Thr Tyr Ala Phe Met Gly Asp Gly Cys Met Met Glu
145 150 155 160

Gly Ile Ser His Glu Val Cys Ser Leu Ala Gly Thr Leu Lys Leu Gly
165 170 175

Lys Leu Ile Ala Phe Tyr Asp Asp Asn Gly Ile Ser Ile Asp Gly His
180 185 190

Val Glu Gly Trp Phe Thr Asp Asp Thr Ala Met Arg Phe Glu Ala Tyr
195 200 205

Gly Trp His Val Ile Arg Asp Ile Asp Gly His Asp Ala Ala Ser Ile
210 215 220

Lys Arg Ala Val Glu Glu Ala Arg Ala Val Thr Asp Lys Pro Ser Leu
225 230 235 240

Leu Met Cys Lys Thr Ile Ile Gly Phe Gly Ser Pro Asn Lys Ala Gly
245 250 255

Thr His Asp Ser His Gly Ala Pro Leu Gly Asp Ala Glu Ile Ala Leu
260 265 270

Thr Arg Glu Gln Leu Gly Trp Lys Tyr Ala Pro Phe Glu Ile Pro Ser
275 280 285

Glu Ile Tyr Ala Gln Trp Asp Ala Lys Glu Ala Gly Gln Ala Lys Glu
 290 295 300
 Ser Ala Trp Asn Glu Lys Phe Ala Ala Tyr Ala Lys Ala Tyr Pro Gln
 305 310 315 320
 Glu Ala Ala Glu Phe Thr Arg Arg Met Lys Gly Glu Met Pro Ser Asp
 325 330 335
 Phe Asp Ala Lys Ala Lys Glu Phe Ile Ala Lys Leu Gln Ala Asn Pro
 340 345 350
 Ala Lys Ile Ala Ser Arg Lys Ala Ser Gln Asn Ala Ile Glu Ala Phe
 355 360 365
 Gly Pro Leu Leu Pro Glu Phe Leu Gly Gly Ser Ala Asp Leu Ala Pro
 370 375 380
 Ser Asn Leu Thr Leu Trp Ser Gly Ser Lys Ala Ile Asn Glu Asp Ala
 385 390 395 400
 Ala Gly Asn Tyr Ile His Tyr Gly Val Arg Glu Phe Gly Met Thr Ala
 405 410 415
 Ile Ala Asn Gly Ile Ser Leu His Gly Gly Phe Leu Pro Tyr Thr Ser
 420 425 430
 Thr Phe Leu Met Phe Val Glu Tyr Ala Arg Asn Ala Val Arg Met Ala
 435 440 445
 Ala Leu Met Lys Gln Arg Gln Val Met Val Tyr Thr His Asp Ser Ile
 450 455 460
 Gly Leu Gly Glu Asp Gly Pro Thr His Gln Pro Val Glu Gln Val Ala
 465 470 475 480
 Ser Leu Arg Val Thr Pro Asn Met Ser Thr Trp Arg Pro Cys Asp Gln
 485 490 495
 Val Glu Ser Ala Val Ala Trp Lys Tyr Gly Val Glu Arg Gln Asp Gly
 500 505 510
 Pro Thr Ala Leu Ile Leu Ser Arg Gln Asn Leu Ala Gln Gln Glu Arg

515

520

525

Thr Glu Glu Gln Leu Ala Asn Ile Ala Arg Gly Gly Tyr Val Leu Lys
 530 535 540

Asp Cys Ala Gly Gln Pro Glu Leu Ile Phe Ile Ala Thr Gly Ser Glu
 545 550 555 560

Val Glu Leu Ala Val Ala Ala Tyr Glu Lys Leu Thr Ala Glu Gly Val
 565 570 575

Lys Ala Arg Val Val Ser Met Ser Ser Thr Asp Ala Phe Asp Lys Gln
 580 585 590

Asp Ala Ala Tyr Arg Glu Ser Val Leu Pro Lys Ala Val Thr Ala Arg
 595 600 605

Val Ala Val Glu Ala Gly Ile Ala Asp Tyr Trp Tyr Lys Tyr Val Gly
 610 615 620

Leu Asn Gly Ala Ile Val Gly Met Thr Thr Phe Gly Glu Ser Ala Pro
 625 630 635 640

Ala Glu Leu Leu Phe Glu Glu Phe Gly Phe Thr Val Asp Asn Val Val
 645 650 655

Ala Lys Ala Lys Glu Leu Leu
 660

<210> 11

<211> 2004

<212> DNA

<213> Escherichia coli

<220>

<221> CDS

<222> (1)..(2001)

<223> tktB CDS for minor Transketolase isozyme

<400> 11

atg tcc cga aaa gac ctt gcc aat gcg att cgc gca ctc agt atg gat 48
 Met Ser Arg Lys Asp Leu Ala Asn Ala Ile Arg Ala Leu Ser Met Asp
 1 5 10 15

gcg gta caa aaa gcc aac tct ggt cat ccc ggc gcg ccg atg ggc atg 96
 Ala Val Gln Lys Ala Asn Ser Gly His Pro Gly Ala Pro Met Gly Met

20	25	30	
gct gat att gcc gaa gtg ctg tgg aac gat ttt ctt aaa cat aac cct Ala Asp Ile Ala Glu Val Leu Trp Asn Asp Phe Leu Lys His Asn Pro 35 40 45			144
acc gac cca acc tgg tat gat cgc gac cgc ttt att ctt tcc aac ggt Thr Asp Pro Thr Trp Tyr Asp Arg Asp Arg Phe Ile Leu Ser Asn Gly 50 55 60			192
cac gcg tcg atg ctg ctc tac agt ttg cta cat ctg acc ggt tac gac His Ala Ser Met Leu Leu Tyr Ser Leu Leu His Leu Thr Gly Tyr Asp 65 70 75 80			240
ctg ccg ctg gaa gaa ctg aag aac ttc cgt cag ttg cat tcg aaa acc Leu Pro Leu Glu Glu Leu Lys Asn Phe Arg Gln Leu His Ser Lys Thr 85 90 95			288
cca ggc cac ccg gag att ggc tat acg cca ggc gtt gaa acc acc acc Pro Gly His Pro Glu Ile Gly Tyr Thr Pro Gly Val Glu Thr Thr Thr 100 105 110			336
ggc ccg ctt gga caa ggt ttg gcg aac gcc gtc ggg ctg gcg ata gca Gly Pro Leu Gly Gln Gly Leu Ala Asn Ala Val Gly Leu Ala Ile Ala 115 120 125			384
gag cgt aca ctg gcg gcg cag ttt aac cag cca gac cat gag atc gtc Glu Arg Thr Leu Ala Ala Gln Phe Asn Gln Pro Asp His Glu Ile Val 130 135 140			432
gat cac ttc acc tat gtg ttt atg ggc gac ggc tgc ctg atg gaa ggt Asp His Phe Thr Tyr Val Phe Met Gly Asp Gly Cys Leu Met Glu Gly 145 150 155 160			480
att tcc cac gaa gtc tgt tcg ctg gca ggc acg ctg gga ctg ggc aag Ile Ser His Glu Val Cys Ser Leu Ala Gly Thr Leu Gly Leu Gly Lys 165 170 175			528
ctg att ggt ttt tac gat cac aac ggt att tcc atc gac ggt gaa aca Leu Ile Gly Phe Tyr Asp His Asn Gly Ile Ser Ile Asp Gly Glu Thr 180 185 190			576
gaa ggc tgg ttt acc gac gat acg gca aaa cgt ttt gaa gcc tat cac Glu Gly Trp Phe Thr Asp Asp Thr Ala Lys Arg Phe Glu Ala Tyr His 195 200 205			624
tgg cat gtg atc cat gaa atc gac ggt cac gat ccg cag gcg gtg aag Trp His Val Ile His Glu Ile Asp Gly His Asp Pro Gln Ala Val Lys 210 215 220			672
gaa gcg atc ctt gaa gcg caa agc gtg aaa gat aag ccg tcg ctg att Glu Ala Ile Leu Glu Ala Gln Ser Val Lys Asp Lys Pro Ser Leu Ile 225 230 235 240			720
atc tgc cgt acg gtg att ggc ttt ggt tcg ccg aat aaa gca ggt aag Ile Cys Arg Thr Val Ile Gly Phe Gly Ser Pro Asn Lys Ala Gly Lys 245 250 255			768

gaa gag gcg cac ggc gca cca ctg ggg gaa gaa gaa gtg gcg ctg gca Glu Glu Ala His Gly Ala Pro Leu Gly Glu Glu Glu Val Ala Leu Ala 260 265 270	816
cgg caa aaa ctg ggc tgg cac cat ccg cca ttt gag atc cct aaa gag Arg Gln Lys Leu Gly Trp His His Pro Pro Phe Glu Ile Pro Lys Glu 275 280 285	864
att tat cac gcc tgg gat gcc cgt gaa aaa ggc gaa aaa gcg cag cag Ile Tyr His Ala Trp Asp Ala Arg Glu Lys Gly Glu Lys Ala Gln Gln 290 295 300	912
agc tgg aat gag aag ttt gcc gcc tat aaa aag gct cat ccg caa ctg Ser Trp Asn Glu Lys Phe Ala Ala Tyr Lys Lys Ala His Pro Gln Leu 305 310 315 320	960
gca gaa gag ttt acc cga cgg atg agc ggt ggt tta ccg aag gac tgg Ala Glu Glu Phe Thr Arg Arg Met Ser Gly Gly Leu Pro Lys Asp Trp 325 330 335	1008
gag aaa acg act cag aaa tat atc aat gag tta cag gca aat ccg gcg Glu Lys Thr Thr Gln Lys Tyr Ile Asn Glu Leu Gln Ala Asn Pro Ala 340 345 350	1056
aaa atc gct acc cgt aag gct tcg caa aat acg ctt aac gct tac ggg Lys Ile Ala Thr Arg Lys Ala Ser Gln Asn Thr Leu Asn Ala Tyr Gly 355 360 365	1104
ccg atg ctg cct gag ttg ctc ggc ggt tcg gcg gat ctg gct ccc agc Pro Met Leu Pro Glu Leu Gly Gly Ser Ala Asp Leu Ala Pro Ser 370 375 380	1152
aac ctg acc atc tgg aaa ggt tct gtt tcg ctg aag gaa gat cca gcg Asn Leu Thr Ile Trp Lys Gly Ser Val Ser Leu Lys Glu Asp Pro Ala 385 390 395 400	1200
ggc aac tac att cac tac ggg gtg cgt gaa ttt ggc atg acc gct atc Gly Asn Tyr Ile His Tyr Gly Val Arg Glu Phe Gly Met Thr Ala Ile 405 410 415	1248
gcc aac ggc atc gcg cac cac ggc ggc ttt gtg ccg tat acc gcg acg Ala Asn Gly Ile Ala His His Gly Gly Phe Val Pro Tyr Thr Ala Thr 420 425 430	1296
ttc ctg atg ttt gtt gaa tac gcc cgt aac gcc gcg cgg atg gcg gca Phe Leu Met Phe Val Glu Tyr Ala Arg Asn Ala Ala Arg Met Ala Ala 435 440 445	1344
ctg atg aaa gcg cgg cag att atg gtt tat acc cac gac tca att ggc Leu Met Lys Ala Arg Gln Ile Met Val Tyr Thr His Asp Ser Ile Gly 450 455 460	1392
ctg ggc gaa gat ggt ccg acg cac cag gct gtt gag caa ctg gcc agc Leu Gly Glu Asp Gly Pro Thr His Gln Ala Val Glu Gln Leu Ala Ser 465 470 475 480	1440

ctg cgc tta acg cca aat ttc agc acc tgg cga ccg tgc gat cag gtg	1488
Leu Arg Leu Thr Pro Asn Phe Ser Thr Trp Arg Pro Cys Asp Gln Val	
485 490 495	
gaa gcg gcg gtg ggc tgg aag ctg gcg gtt gag cgc cac aac gga ccg	1536
Glu Ala Ala Val Gly Trp Lys Leu Ala Val Glu Arg His Asn Gly Pro	
500 505 510	
acg gca ctg atc ctc tca agg cag aat ctg gcc cag gtg gaa cgt acg	1584
Thr Ala Leu Ile Leu Ser Arg Gln Asn Leu Ala Gln Val Glu Arg Thr	
515 520 525	
ccg gat cag gtt aaa gag att gct cgt ggc ggt tat gtg ctg aaa gac	1632
Pro Asp Gln Val Lys Glu Ile Ala Arg Gly Gly Tyr Val Leu Lys Asp	
530 535 540	
agc ggc ggt aag cca gat att att ctg att gcc acc ggt tca gag atg	1680
Ser Gly Gly Lys Pro Asp Ile Ile Leu Ile Ala Thr Gly Ser Glu Met	
545 550 555 560	
gaa att acc ctg caa gcg gca gag aaa tta gca gga gaa ggt cgc aat	1728
Glu Ile Thr Leu Gln Ala Ala Glu Lys Leu Ala Gly Glu Gly Arg Asn	
565 570 575	
gta cgc gta gtt tcc ctg ccc tcg acc gat att ttc gac gcc cag gat	1776
Val Arg Val Val Ser Leu Pro Ser Thr Asp Ile Phe Asp Ala Gln Asp	
580 585 590	
gag gaa tat cgg gag tcg gtg ttg cct tct aac gtt gcg gct cgc gtg	1824
Glu Glu Tyr Arg Glu Ser Val Leu Pro Ser Asn Val Ala Ala Arg Val	
595 600 605	
gcg gtg gaa gca ggt att gcc gat tac tgg tac aag tat gtt ggt ctg	1872
Ala Val Glu Ala Gly Ile Ala Asp Tyr Trp Tyr Lys Tyr Val Gly Leu	
610 615 620	
aaa ggg gca att gtc ggg atg acg ggt tac ggg gaa tct gct ccg gcg	1920
Lys Gly Ala Ile Val Gly Met Thr Gly Tyr Gly Glu Ser Ala Pro Ala	
625 630 635 640	
gat aag ctg ttc ccg ttc ttt ggc ttt acc gcc gag aat att gtg gca	1968
Asp Lys Leu Phe Pro Phe Phe Gly Phe Thr Ala Glu Asn Ile Val Ala	
645 650 655	
aaa gcg cat aag gtg ctg gga gtg aaa ggt gcc tga	2004
Lys Ala His Lys Val Leu Gly Val Lys Gly Ala	
660 665	

<210> 12
 <211> 667
 <212> PRT
 <213> Escherichia coli

<400> 12

Met Ser Arg Lys Asp Leu Ala Asn Ala Ile Arg Ala Leu Ser Met Asp

1 5 10 15

Ala Val Gln Lys Ala Asn Ser Gly His Pro Gly Ala Pro Met Gly Met
20 25 30

Ala Asp Ile Ala Glu Val Leu Trp Asn Asp Phe Leu Lys His Asn Pro
35 40 45

Thr Asp Pro Thr Trp Tyr Asp Arg Asp Arg Phe Ile Leu Ser Asn Gly
50 55 60

His Ala Ser Met Leu Leu Tyr Ser Leu Leu His Leu Thr Gly Tyr Asp
65 70 75 80

Leu Pro Leu Glu Glu Leu Lys Asn Phe Arg Gln Leu His Ser Lys Thr
85 90 95

Pro Gly His Pro Glu Ile Gly Tyr Thr Pro Gly Val Glu Thr Thr Thr
100 105 110

Gly Pro Leu Gly Gln Gly Leu Ala Asn Ala Val Gly Leu Ala Ile Ala
115 120 125

Glu Arg Thr Leu Ala Ala Gln Phe Asn Gln Pro Asp His Glu Ile Val
130 135 140

Asp His Phe Thr Tyr Val Phe Met Gly Asp Gly Cys Leu Met Glu Gly
145 150 155 160

Ile Ser His Glu Val Cys Ser Leu Ala Gly Thr Leu Gly Leu Gly Lys
165 170 175

Leu Ile Gly Phe Tyr Asp His Asn Gly Ile Ser Ile Asp Gly Glu Thr
180 185 190

Glu Gly Trp Phe Thr Asp Asp Thr Ala Lys Arg Phe Glu Ala Tyr His
195 200 205

Trp His Val Ile His Glu Ile Asp Gly His Asp Pro Gln Ala Val Lys
210 215 220

Glu Ala Ile Leu Glu Ala Gln Ser Val Lys Asp Lys Pro Ser Leu Ile

225 230 235 240
 Ile Cys Arg Thr Val Ile Gly Phe Gly Ser Pro Asn Lys Ala Gly Lys
 245 250 255
 Glu Glu Ala His Gly Ala Pro Leu Gly Glu Glu Glu Val Ala Leu Ala
 260 265 270
 Arg Gln Lys Leu Gly Trp His His Pro Pro Phe Glu Ile Pro Lys Glu
 275 280 285
 Ile Tyr His Ala Trp Asp Ala Arg Glu Lys Gly Glu Lys Ala Gln Gln
 290 295 300
 Ser Trp Asn Glu Lys Phe Ala Ala Tyr Lys Lys Ala His Pro Gln Leu
 305 310 315 320
 Ala Glu Glu Phe Thr Arg Arg Met Ser Gly Gly Leu Pro Lys Asp Trp
 325 330 335
 Glu Lys Thr Thr Gln Lys Tyr Ile Asn Glu Leu Gln Ala Asn Pro Ala
 340 345 350
 Lys Ile Ala Thr Arg Lys Ala Ser Gln Asn Thr Leu Asn Ala Tyr Gly
 355 360 365
 Pro Met Leu Pro Glu Leu Leu Gly Gly Ser Ala Asp Leu Ala Pro Ser
 370 375 380
 Asn Leu Thr Ile Trp Lys Gly Ser Val Ser Leu Lys Glu Asp Pro Ala
 385 390 395 400
 Gly Asn Tyr Ile His Tyr Gly Val Arg Glu Phe Gly Met Thr Ala Ile
 405 410 415
 Ala Asn Gly Ile Ala His His Gly Gly Phe Val Pro Tyr Thr Ala Thr
 420 425 430
 Phe Leu Met Phe Val Glu Tyr Ala Arg Asn Ala Ala Arg Met Ala Ala
 435 440 445
 Leu Met Lys Ala Arg Gln Ile Met Val Tyr Thr His Asp Ser Ile Gly
 450 455 460

Leu Gly Glu Asp Gly Pro Thr His Gln Ala Val Glu Gln Leu Ala Ser
 465 470 475 480
 Leu Arg Leu Thr Pro Asn Phe Ser Thr Trp Arg Pro Cys Asp Gln Val
 485 490 495
 Glu Ala Ala Val Gly Trp Lys Leu Ala Val Glu Arg His Asn Gly Pro
 500 505 510
 Thr Ala Leu Ile Leu Ser Arg Gln Asn Leu Ala Gln Val Glu Arg Thr
 515 520 525
 Pro Asp Gln Val Lys Glu Ile Ala Arg Gly Gly Tyr Val Leu Lys Asp
 530 535 540
 Ser Gly Gly Lys Pro Asp Ile Ile Leu Ile Ala Thr Gly Ser Glu Met
 545 550 555 560
 Glu Ile Thr Leu Gln Ala Ala Glu Lys Leu Ala Gly Glu Gly Arg Asn
 565 570 575
 Val Arg Val Val Ser Leu Pro Ser Thr Asp Ile Phe Asp Ala Gln Asp
 580 585 590
 Glu Glu Tyr Arg Glu Ser Val Leu Pro Ser Asn Val Ala Ala Arg Val
 595 600 605
 Ala Val Glu Ala Gly Ile Ala Asp Tyr Trp Tyr Lys Tyr Val Gly Leu
 610 615 620
 Lys Gly Ala Ile Val Gly Met Thr Gly Tyr Gly Glu Ser Ala Pro Ala
 625 630 635 640
 Asp Lys Leu Phe Pro Phe Phe Gly Phe Thr Ala Glu Asn Ile Val Ala
 645 650 655
 Lys Ala His Lys Val Leu Gly Val Lys Gly Ala
 660 665

<210> 13
 <211> 27
 <212> DNA

<213> Artificial

<220>

<223> Primer JWF 430

<400> 13

gctctagatg cagtggcaaa ctaaact

27

<210> 14

<211> 29

<212> DNA

<213> Artificial

<220>

<223> Primer JWF 449

<400> 14

tagctctccg tcacgttact agatctcag

29

<210> 15

<211> 29

<212> DNA

<213> Artificial

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<223> Primer JWF 484

<400> 15

gacggatcct ataaggagca tcgctcatg

29

<210> 16

<211> 30

<212> DNA

<213> Artificial

<220>

<223> Primer JWF 529

<400> 16

tagctctccg tcacgttact gacgtcgaag

30

<210> 17

<211> 20

<212> DNA

<213> Artificial

<220>

<223> Primer JWF 501

<400> 17

gacaggaata aggagcatcg

20

<210> 18
<211> 20
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 499

<400> 18
ggagggtaaac ggtacgtggt

20

<210> 19
<211> 28
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 541

<400> 19
ggaattcgca taaacaggat cgccatca

28

<210> 20
<211> 26
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 542

<400> 20
ctggatcctt aagccacgcg agccgt

26

<210> 21
<211> 29
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 610

<400> 21
gtggatcctt aatccgttca tagtgtaaa

29

<210> 22
<211> 27
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 611

<400> 22
tgggatccat gagaaagccg actgcaa 27

<210> 23
<211> 20
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 625

<400> 23
gttcgtcagt gcaggatgga 20

<210> 24
<211> 22
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 626

<400> 24
gttcaggcgt gagttttctg ct 22

<210> 25
<211> 28
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 541

<400> 25
ggaattcgca taaacaggat cgccatca 28

<210> 26
<211> 26
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 542

<400> 26
ctggatcctt aagccacgcg agccgt 26

<210> 27
<211> 21
<212> DNA
<213> Artificial

<220>

<223> Primer JWF 636

<400> 27

tccgtactgc gcgtattgag a

21

<210> 28

<211> 20

<212> DNA

<213> Artificial

<220>

<223> Primer JWF 637

<400> 28

agaggcgagt ttttcgacca

20

<210> 29

<211> 20

<212> DNA

<213> Artificial

<220>

<223> Primer JWF 669

<400> 29

gcagcattgt gccgccagaa

20

<210> 30

<211> 20

<212> DNA

<213> Artificial

<220>

<223> Primer JWF 670

<400> 30

gtgcgctggt gaaatatctt

20

<210> 31

<211> 27

<212> DNA

<213> Artificial

<220>

<223> Primer JWF 599

<400> 31

ggaattcgac aggaataagg agcatcg

27

<210> 32

<211> 29
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 560

<400> 32
gacggatcct catttcactg cctctcgat

29

<210> 33
<211> 29
<212> DNA

<213> Artificial

<220>
<223> Primer JWF 484

<400> 33
gacggatcct ataaggagca tcgctcatg

29

<210> 34
<211> 30
<212> DNA
<213> Artificial

<220>
<223> Primer JWF 529

<400> 34
tagctctccg tcacgttact gacgtcgaag

30